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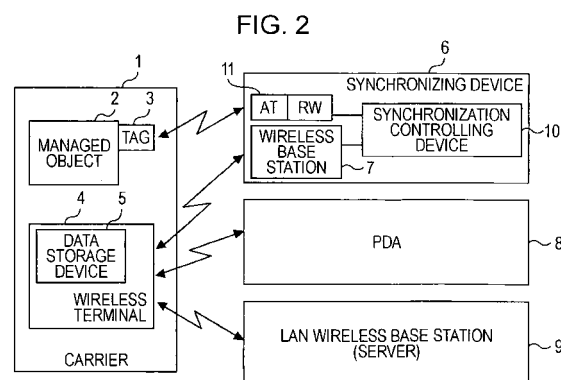
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(54) **INFORMATION SYNCHRONIZATION SYSTEM**

(57) An information synchronizing system includes a wireless communication terminal including a first information storage device having a first wireless communication range and a second information storage device having a second wireless communication range, the second wireless communication range being larger than the first wireless communication range; a read/write device that reads information from and writes information to the first information storage device; a wireless communication base station capable of performing wireless communication with the wireless communication terminal; and a synchronization controlling device that writes information stored in the first information storage device, the information being read using the read/write device, to the second information storage device via the wireless communication base station and the wireless communication terminal.



Description

Technical Field

[0001] The present invention relates to a synchronizing system in which, in a case where a first information storage device having a short-distance wireless communication function is provided on a carrier that moves, synchronization can be achieved flexibly even for information that is to be written to the first information storage device particularly at a distant place where communication by the first information storage device is not allowed.

Background Art

[0002] RFID (radio frequency identification) is expected to serve as technologies for improving the efficiency of production and distribution.

[0003] Generally, when data is written to an RFID tag, in many cases, the writing of information to the RFID tag is not the end of all processing. Usually, the data written to the RFID tag is updated for the purpose of product management or process management.

[0004] For example, when a process such as processing of a product is managed, an RFID tag is attached to an object that is processed, and the process of processing is managed using information regarding the object that is processed (lot information, information regarding the type of processing, information regarding the material, information regarding the delivery date, and so forth), stored in the RFID tag.

[0005] In this case, the RFID tag attached to the object that is processed, entering the process of processing, has written thereon initial information regarding the object that is processed, such as a lot number, a delivery date, a current stage of processing, and so forth, and the information must be updated each time the object is processed. The updated information at the time of completion of the process of processing is read from the RFID tag as final product information, and is sent to a server for management and is maintained in a predetermined state of management.

Disclosure of Invention

Problems to be Solved by the Invention

[0006] In order to update the information of the RFID tag in a plurality of processes, such as the process of processing described above, each time the information is updated, it is necessary to write information or read information from the RFID tag using an RFID-tag read/write device (hereinafter simply referred to as a read/write device). In such a system, however, expensive read/write devices must be provided for all the processes, which inevitably incurs high cost. At the same time, in order to transmit information updated in the process of processing to a server or the like of a management de-

vice, a wireless LAN having a communication range on the order of several hundred meters is suitable.

[0007] An example of an attempt for enriching the manners of use of RFIDs by using a wireless LAN in combination is an RFID read/write device with a wireless LAN function. This is an attempt to increase the range of use of the read/write device by connecting the read/write device with a processing system to which information is transferred using a wireless LAN.

[0008] More specifically, the read/write device is integrated with a wireless LAN terminal so that it can be carried portably, so that free movement is allowed while maintaining a wireless connection by the wireless LAN with a processing system such as a server. Accordingly, by a worker moving the read/write device and placing it against a managed object in accordance with the state of carriage of the object, it is possible to perform communication with the RFID tag attached to the managed object at an arbitrary place, and to transfer information of the RFID tag obtained through the communication to the server.

[0009] However, since the communication range of an RFID tag is several ten centimeters, which is extremely small, according to the techniques described above, the worker who operates the read/write device that performs communication with the RFID tag must move around in accordance with movement of the object being processed. This causes an infinitely large burden on the worker.

[0010] Furthermore, as an application of the techniques described above, it is conceivable to install the read/write device with the wireless LAN function on a carrying device (carrier) so that information of the RFID tag attached to a managed object on the carrying device can be transmitted to a remote location through communication via the wireless LAN.

[0011] However, since read/write devices are expensive, it is not practical to install read/write devices on all carrying devices.

[0012] Accordingly, the present invention has been made in view of the situation described above, and it is an object thereof to provide at a low price a practical information synchronizing system with which information stored in a storage device such as an RFID tag attached to a carrier that moves can be synchronized accurately with, for example, information on the side of a managing device.

Means for Solving the Problems

[0013] In order to achieve the above object, according to the present invention, there is provided an information synchronizing system including a wireless communication terminal including a first information storage device having a first wireless communication range and a second information storage device having a second wireless communication range, the second wireless communication range being larger than the first wireless communi-

cation range; a read/write device that reads information from and writes information to the first information storage device; a wireless communication base station capable of performing wireless communication with the wireless communication terminal; and a synchronization controlling device that writes information stored in the first information storage device, the information being read using the read/write device, to the second information storage device via the wireless communication base station and the wireless communication terminal.

[0014] The synchronization controlling device may write information stored in the second information storage device, the information being read via the wireless communication terminal and the wireless communication base station, to the first information storage device using the read/write device.

[0015] In order to achieve the above object, according to the present invention, there is provided an information synchronizing system including a wireless communication terminal including a first information storage device having a first wireless communication range and a second information storage device having a second wireless communication range, the second wireless communication range being larger than the first wireless communication range; a read/write device that reads information from and writes information to the first information storage device; a wireless communication base station capable of performing wireless communication with the wireless communication terminal; and a synchronization controlling device that writes information stored in the second information storage device, the information being read via the wireless communication terminal and the wireless communication base station, to the first information storage device using the read/write device.

[0016] The synchronization controlling device may write information stored in the first information storage device, the information being read using the read/write device, to the second information storage device via the wireless communication base station and the wireless communication terminal.

[0017] In order to achieve the above object, according to the present invention, there is provided an information synchronizing system including a first wireless communication terminal including a first information storage device having a first wireless communication range and a second information storage device having a second wireless communication range, the second wireless communication range being larger than the first wireless communication range; a read/write device that reads information from and writes information to the first information storage device; a wireless communication base station capable of performing wireless communication with the wireless communication terminal; and a synchronization controlling device that synchronizes information stored in the first information storage device and information stored in the second information storage device, wherein the synchronization controlling device writes the information stored in the first information storage device, the in-

formation being read using the read/write device, to the second information storage device via the wireless communication base station and the first wireless communication terminal, and wherein the synchronization controlling device writes the information stored in the second information storage device, the information being read via the first wireless communication terminal and the wireless communication base station, to the first information storage device using the read/write device.

[0018] The synchronization controlling device may read the information stored in the first information storage device using the read/write device upon the read/write device entering the first wireless communication range.

[0019] After the synchronization controlling device reads the information stored in the first information storage device using the read/write device, the synchronization controlling device may write the information that has been read to the second information storage device via the wireless communication base station and the first wireless communication terminal.

[0020] The synchronization controlling device may read in advance the information stored in the second information storage device via the wireless communication base station and the first wireless communication terminal, and the synchronization controlling device may write the information that has been read to the first information storage device using the read/write device upon the read/write device entering the first wireless communication range.

[0021] The information synchronizing system may further include a second wireless communication terminal, the first wireless communication terminal and the second wireless communication terminal may exist in a communication range of the wireless base station, and the wireless base station may perform communication only with the first wireless communication terminal.

[0022] The intensity of a wireless signal of the first wireless communication terminal may be greater than a predetermined intensity or the intensity of a wireless signal of the second wireless communication terminal.

[0023] Communication with the wireless communication base station may become possible earlier for the first wireless communication terminal than for the second wireless communication terminal.

[0024] The first wireless communication terminal may have first unique information matching unique information of the first information storage device, the second wireless communication terminal may have second unique information different from the first unique information, and the wireless communication base station may read the first unique information of the first wireless communication terminal and the second unique information of the second wireless communication terminal.

[0025] The information synchronizing system may further include a second wireless communication terminal, and a communication range of the wireless communication base station may be set to be a range where wireless communication is allowed only with the first wireless com-

munication terminal.

[0026] The wireless communication base station may perform communication with the first wireless communication terminal via a wireless antenna having such a communication distance that only one carrier is possible to enter within the communication distance.

[0027] The first wireless communication terminal may be provided on a movable carrier.

[0028] The read/write device, the wireless communication base station, and the synchronization controlling device may be provided in a synchronizing device that moves relative to the carrier.

[0029] The wireless communication base station and the synchronization controlling device may be provided in a synchronizing device that moves relative to the carrier, and the read/write device may be provided on a portable device that can be carried separately from the synchronizing device.

[0030] The information synchronizing system may further include a read/write-device moving device that moves the read/write device with the synchronizing device for a predetermined distance together with the carrier.

[0031] The information synchronizing system may further include a read/write-device moving device that moves the read/write device for a predetermined distance together with the carrier.

[0032] The information synchronizing device may further include a device that determines, in a case where the information in the first information storage device and the information in the second information storage device are to be synchronized, whether synchronization is to be achieved by using the information in the first information storage device or by using the information in the second information storage device according to a position where the synchronizing device is provided.

[0033] The information synchronizing system may further include a device that, on the basis of time of communication regarding information to be synchronized maintained in the first information storage device and the first wireless communication terminal, which information is to be used for synchronization.

[0034] The device may cause synchronization to be performed on the basis of information with latest communication time.

[0035] The synchronizing device may be connected to an information management device, and the synchronizing device may transfer at least part of the information stored in the first information storage device to the information management device so that the transferred information is maintained therein.

[0036] The synchronizing device may be connected to an information management device, and the synchronizing device may transfer at least part of the information stored in the second information storage device to the information management device so that the transferred information is maintained therein.

[0037] The synchronizing device may be connected to

an information management device, and the synchronizing device may transfer at least part of the information stored in the first information storage device and at least part of the information stored in the second information storage device to the information management device so that the transferred information is maintained therein.

[0038] The synchronizing device may be connected to an information management device, and it may be possible to arbitrarily select information to be synchronized and information to be transferred to and maintained in a database of the information management device among the information stored in the first information storage device.

[0039] The synchronizing device may be connected to an information management device, and it may be possible to arbitrarily select information to be synchronized and information to be transferred to and maintained in a database of the information management device among the information stored in the second information storage device.

[0040] The synchronizing device may be connected to an information management device, and it may be possible to arbitrarily select information to be synchronized and information to be transferred to and maintained in a database of the information management device among the information stored in the first information storage device and the information stored in the second information storage device.

[0041] The information synchronizing system may further include a device that writes information stored in a database of a management device connected to the synchronizing device to at least one of the first information storage device and the second information storage device.

Advantages

[0042] As described above, according to the present invention, a short-distance communication device capable of performing communication only at a short distance, implemented by a combination of a first storage device and a read/write device, and a long-distance communication device supporting a longer communication distance, implemented by a combination of a wireless communication terminal and a wireless communication base station, are both provided. Thus, communication is performed by the short-distance communication device only when the first storage device (i.e., a carrier) comes to a predetermined short distance from the read/write device, while only information stored in the second information storage device is updated by the long-distance communication device when the carrier exists at a long distance.

[0043] When it has become possible for the carrier to perform communication using the short-distance communication device, communication using both communication devices becomes possible, so that an attempt is made to achieve synchronization between content stored in the first storage device and content stored in

the second storage device instantaneously at that time.

[0044] With this configuration, without the need for costly devices, such as expensive read/write devices provided on individual carriers, updating of stored content at an arbitrary place is allowed, so that it is possible to implement an extremely practical information synchronizing system.

Brief Description of Drawings

[0045]

Fig. 1 is schematic diagram showing a scheme of a managed object with an RFID tag according to an embodiment of the present invention.

Fig. 2 is a schematic diagram for showing an information synchronizing system according to the embodiment of the present invention.

Fig. 3 is a schematic diagram showing an example of application of an information synchronizing system according to the embodiment of the present invention.

Fig. 4 is a schematic diagram of a loading area that can be used in the system shown in Fig. 3.

Fig. 5 is a schematic diagram of a shipping area that can be used in the system shown in Fig. 3.

Reference Numerals

[0046]

- 1 carrier
- 2 managed object
- 3 RFID tag
- 4 wireless communication terminal
- 5 data storage device
- 6 synchronizing device
- 7 wireless communication base station
- 8 PDA (portable wireless communication terminal)
- 9 LAN wireless communication base station
- 11 RFID tag antenna

Best Mode for Carrying Out the Invention

[0047] Now, an embodiment of the present invention will be described with reference to the accompanying drawings to aid understanding of the present invention. The embodiment described below is only an exemplary embodiment of the present invention, and is not intended to limit the technical scope of the present invention.

[0048] First, an overall configuration of this embodiment will be described using a schematic diagram shown in Fig. 2.

[0049] A carrier 1, such as a crane or a carrier truck, moves with a managed object 2 carried thereon, such as an object that is processed.

[0050] The managed object 2 has provided thereon an RFID tag 3.

[0051] On the carrier 1, in addition to the managed object 2, a wireless communication terminal 4 is provided. The wireless communication terminal 4 has a wireless communication function supporting a longer distance than that of the RFID tag 3. Furthermore, the wireless communication terminal 4 has or is connected to a data storage device 5 that is separate from the RFID tag 3.

[0052] The wireless communication terminal 4 of the carrier 1 configured as described above is capable of performing long-distance wireless communication from the RFID tag 3 with, for example, a wireless base station 7 provided in a synchronizing device 6, a PDA 8 having a wireless function, or a LAN wireless communication base station 9 that performs communication via a wireless LAN, which are separate from the carrier 1.

[0053] Among the synchronizing device 6, the PDA 8, and the LAN wireless communication base station 9, the synchronizing device 6 has a special configuration.

[0054] More specifically, the synchronizing device 6, the PDA 8, and the LAN wireless communication base station 9 perform wireless communication at relatively long distances with the wireless communication terminal 4. The synchronizing device 6 performs long-distance wireless communication with the wireless communication terminal 4 via the wireless communication base station 7 thereof. Furthermore, in addition to having functions for performing wireless communication via the wireless communication base station 7 at relatively long distances similarly to the PDA 8 and the LAN wireless communication base station 9, the synchronizing device 6 has a read/write device RW, and by using it, has a function of performing short-distance wireless communication with the RFID tag 3 attached to the managed object 2 on the carrier 1. Furthermore, in addition to the read/write device RW and the wireless communication base station 7, the synchronizing device 6 includes a synchronization controlling device 10 that controls the read/write device RW and the wireless communication base station 7 and that has a storage function.

[0055] Thus, when the carrier 1 comes into a range where communication with the read/write device RW of the RFID tag 3 is allowed, the RFID tag 3 and the read/write device RW perform communication so that information stored in the RFID tag 3 is transmitted to the wireless communication base station 7 via the synchronization controlling device 10. Furthermore, this information is stored in the data storage device 5 connected to the wireless communication terminal 4 through communication between the wireless communication base station 7 and the wireless communication terminal 4 on the carrier 1.

[0056] Furthermore, since the communication range of the wireless communication terminal 4 is large, the information stored in the data storage device 5 can be updated at an arbitrary timing by the wireless communication terminal 4 performing communication with the PDA 8, the LAN wireless communication base station 9,

or the wireless communication base station 7 of the synchronizing device 6.

[0057] Furthermore, upon the carrier 1 moving into the vicinity of the synchronizing device 6 again, through communication between the read/write device RW and the RFID tag 3, the information written to the data storage device 5 is written to the RFID tag 3 via the data storage device 5 → the wireless communication base station 7 → the synchronization controlling device 10 → the read/write device RW.

[0058] Thus, the information read from the RFID tag 3 is first written to the data storage device 5 of the wireless communication terminal 4. Then, even when the carrier 1 is in a place distant from the synchronizing device 6, the information written to the data storage device 5 is updated. Finally, the updated data is written to the RFID tag 3 again, whereby synchronization is achieved between the information stored in the RFID tag 3 and the information in the data storage device 5 of the wireless communication terminal 4.

[0059] Although the wireless communication base station, the synchronization controlling device, and the read/write device RW are provided in a synchronizing device that moves relative to the carrier as described above, the read/write device RW may be provided on a portable device that can be carried, further provided separately from the synchronizing device. This is because, in many cases, operation is facilitated if an operator can carry the small read/write device RW alone.

[0060] Next, the embodiment will be described in more detail.

[0061] The carrier 1, which is a component of this system, carries thereon the managed object 2, the RFID tag 3 attached to the managed object 2, the wireless communication terminal 4, and the data storage device 5 connected to the wireless communication terminal 4 (refer to Figs. 1 and 2).

[0062] The RFID tag 3 is a storage device with which certain information can be read, written, and saved from outside via wireless signals and that has a communication range of a relatively short distance, such as the UHF band, and application thereof to management of production and distribution is expected.

[0063] The carrier 1 is a carrying device for carrying the managed object 2. It may be of the type that hangs the managed object 2, such as a crane, or of the type that carries the managed object 2 on a tray. It also may be of the type that is not segmented for each managed object 2, such as a belt conveyor. In this case, individual segments where the managed objects 2 are managed should be considered as independent and separate portions.

[0064] As described earlier, the carrier 1 includes the wireless communication terminal 4. This is a terminal having a long-distance wireless communication function with a communication range larger than that of the RFID tag 3, and having a CPU, a memory, and so forth. Similarly to the RFID tag 3, it can read, write, and save certain

information from outside via wireless signals. Furthermore, the wireless communication terminal 4 can perform communication at a longer distance than the RFID tag 3 or while moving at a rapid speed, via a wireless LAN conforming to the IEEE 802.11 standard or the like. Instead of the IEEE 802.11 standard, the wireless standard used for communication by the wireless communication terminal 4 may be a standard included in the IEEE 802.15 standard, such as the Bluetooth standard or the ZigBee standard, and a standard suitable for an intended application in view of communication distance, noise endurance, or other factors should be selected.

[0065] The wireless communication terminal 4 has a long-distance wireless communication range as described above. Thus, the wireless communication terminal 4 included in the carrier 1 is accessed via the long-distance wireless by the wireless-enabled PDA 8 carried by a worker, the LAN wireless communication base station 9 connected to a server on a network, the synchronizing device described earlier, and so forth. It is possible to write information of the managed object 2 to the RFID tag 3, read information of the managed object 2 maintained by the wireless communication terminal 4, or add new information that occurs in the course of production or distribution.

[0066] Although such a configuration is possible where a wireless apparatus such as the external synchronization device 6 or PDA 8 and the wireless communication terminal 4 included in the carrier 1 perform communication directly, such a configuration is also possible where the wireless communication base station 7 is provided in the middle and communication is performed via the wireless communication base station 7. Now, a case where the wireless communication base station 7 is used will be described.

[0067] In order to achieve synchronization between information maintained in the RFID tag 3 attached to the managed object 2 and information maintained in the wireless communication terminal 4 (stored in the data storage device 5), in this system, the synchronizing device 6 is introduced (refer to Fig. 2).

[0068] This includes the read/write device RW having an RFID antenna 11 for accessing the RFID tag 3, the wireless communication base station 7 for accessing the wireless communication terminal 4 on the carrier 1, and the synchronization controlling device 10 that performs a synchronizing process via these devices.

[0069] The synchronization controlling device 10 performs communication with the RFID tag 3 and the wireless communication terminal 4 individually, and performs a synchronizing process so that information maintained by these devices becomes the same. A specific method of the synchronizing process will be described later again.

[0070] By providing the synchronizing device 6 at a certain place within a range where electromagnetic waves of the RFID tag 3 reach and performing the synchronizing process, the range of use where it is difficult

to use the RFID tag 3 can be increased drastically, such as a case where the carrier 1 is in a range where communication with the RFID tag 3 is not allowed or the speed of movement of the carrier 1 is so fast that communication between the RFID tag 3 and the read/write device RW is not allowed. As an example of specific implementation, the synchronizing process is performed to move information of the RFID tag 3 to the wireless communication terminal 4, then the information is updated by accessing the information stored on the wireless communication terminal 4, and the updated information is finally returned to the RFID tag 3 through the inverse path of the path of the information.

[0071] More specifically, for example, the synchronizing process is performed at a timing described below.

[0072] When the carrier 1 has entered the vicinity of the synchronizing device 6 and the RFID tag 3 on the carrier 1 has responded to the read/write device RW, the read/write device RW reads the information maintained in the RFID tag 3, and sends the information to the synchronization controlling device 10. Upon receiving the information of the RFID tag 3, the synchronization controlling device 10 checks a response from the wireless communication terminal 4 on the carrier 1, and if a response is received, writes received information to the data storage device 5 of the wireless communication terminal 4.

[0073] Alternatively, as described earlier, when the read/write device RW has entered the communication range of the RFID tag 3, the synchronization controlling device 10 reads the information stored in the data storage device 5 of the wireless communication terminal 4 via the wireless communication base station 7, and writes the information to the RFID tag 3 via the read/write device RW.

[0074] Accordingly, under the intervention of the synchronization controlling device 10, information is transferred from the RFID tag 3 to the data storage device 5 or from the data storage device 5 to the RFID tag 3 so that mutual synchronization of the content stored in these devices is achieved.

[0075] In this case, the synchronization controlling device 10 may read information from the second information storage device 5 via the wireless communication base station 7 and the wireless communication terminal 4 in advance and store the information, and further the read/write device RW may write the information to the RFID tag 3 when the read/write device RW has entered the communication range of the RFID tag 3.

[0076] When the synchronizing device 6 has entered the communication range of the RFID tag 3 having a short communication distance and the information maintained therein has been read successfully, the synchronizing device 6 starts the synchronizing process.

[0077] Although the antenna 11 of the read/write device RW may be fixed on the read/write device RW, there can be cases where it is portable and a worker manually moves the antenna to perform communication with the

RFID tag 3. The read/write device RW itself may also be portable.

[0078] In this case, first, when the carrier 1 has entered the communication range of the RFID tag 3 in the vicinity of the synchronizing device 6, a worker or the like manually places the antenna 11 against the RFID tag 3, and the read/write device RW reads information maintained by the RFID tag 3 and sends the information to the synchronization controlling device 10. Upon receiving the information of the RFID tag 3, the synchronization controlling device 10 checks a response from the wireless communication terminal 4 on the carrier 1 via the wireless communication base station 7, and if a response is received, reads the information maintained in the wireless communication terminal 4.

[0079] Furthermore, there are cases where synchronization must be achieved while the carrier is moving at a considerable speed. In this case, if the relative speed between the first information storage device (the RFID tag 3) and the read/write device is large, it could become impossible to perform updating between the first information storage device and the read/write device. Thus, by providing a read/write-device moving device that moves the first information storage device and the read/write device together with the synchronizing device 6 or alone for a predetermined distance together with the carrier 1, with the read/write-device moving device, the relative speed becomes 0 or extremely small, so that problems such as the updating failure described above are avoided. A conceivable example is an antenna moving device that is provided near a conveyor and that moves a predetermined distance reciprocally together with managed objects mounted on the conveyor.

[0080] Upon obtaining information maintained in both devices, the synchronization controlling device 10 performs the synchronizing process. Information of which device is maintained will be described later.

[0081] For example, in a case where a wireless LAN conforming to IEEE 802.11 is used, the communication range of the wireless communication terminal 4 is as large as several hundred meters. Thus, there is a possibility that a plurality of wireless communication terminals 4 exists in the communication range so that it is not possible to identify the wireless communication terminal 4 performing communication with the RFID tag 3 on the carrier 1.

[0082] The following is a conceivable method of identifying the wireless communication terminal 4.

[0083] First, the communication area of the wireless communication base station 7 is restricted to only a needed area, and a situation is made where there exists only one wireless communication terminal 4 therein, so that the wireless communication terminal 4 is identified.

[0084] For example, when carriers 1 (wireless communication terminals 4) are disposed and carried on a conveyor at regular intervals, it is conceivable to restrict the communication range of the wireless communication terminal 4 to a communication range narrower than the dis-

tance between the carriers 1. Alternatively, it is possible to restrict the direction of transmission of wireless signals to only a needed area using a directional antenna.

[0085] Even if the communication area of the wireless communication base station 7 is restricted as described above, it is possible that a plurality of wireless communication terminals 4 enters the communication range.

[0086] In this case, first, the intensities of wireless signals used for communication between the wireless communication base station 7 and the wireless communication terminal 4 are compared, and the wireless communication terminal 4 with the stronger intensity is identified.

[0087] Furthermore, at production and logistic sites, routes of movement of carriers 1 are restricted to a certain extent. Thus, depending on factors such as the antenna directivity of the wireless communication base station 7, it is possible to predict in advance a point where the intensity of wireless signals becomes most intense on the route. Therefore, by designing the antenna directivity of the wireless communication base station 7 so that the intensity of wireless signals for communication between the wireless communication base station 7 and the wireless communication terminal 4 becomes most intense at a point of reading signals of the RFID tag 3, such as the center point of the loop antenna of the read/write device RW, it becomes possible to identify the wireless communication terminal 4.

[0088] However, in the case of a configuration where the RFID tag 3 is read while moving the read/write device RW of the synchronizing device 6, in some cases, it is not possible to fix a point of reading signals of the RFID tag 3.

[0089] In that case, a conceivable method is to identify wireless communication terminals 4 in order of their entry into the communication area. That is, a carrier that enters the communication range earliest is identified as a counterparty of communication.

[0090] As described above, at production and distribution sites, since the route of movement of carriers 1 is restricted to some extent, by determining a communication range, it is possible to recognize the order of entry of the carrier 1 into the communication range.

[0091] Thus, in the case of this method, for example, assuming that a worker moves the antenna of the read/write device RW to read information of the RFID tag 3, information of the RFID tag 3 can be read by placing the read/write device RW against it in order of entry of carriers 1 into the work area.

[0092] By providing a display lamp or the like on the carrier 1 so that the worker is notified of selection upon selection of the wireless communication terminal 4 by the synchronization controlling device 10, the processing is further facilitated.

[0093] In some RFID tags, unique ID numbers for identifying the tags are embedded. In the case where the unique ID number having the RFID tag 3 is not included in information that is to be synchronized, it is necessary to perform the synchronizing process in a certain way

and to write the unique ID number to the data storage device 5 of the wireless communication terminal 4. In this case, the subsequent synchronizing process is performed as follows. When the worker has moved the antenna of the read/write device RW to read the RFID tag 3 on a certain carrier 1, the synchronization controlling device 10 first reads unique ID number information from all the communication terminals existing in the communication range, and selects one matching that of the RFID tag 3 as a synchronization target.

[0094] In this way, regardless of the order of entry of carriers 1 into the communication range, the worker can perform the synchronizing process by reading an RFID tag 3 from an arbitrary carrier 1 existing in the communication range.

[0095] As specifics of the synchronization process, first, a conceivable method is to determine whether to use content maintained at the RFID tag 3 or content maintained at the wireless communication terminal 4 according to the position where the synchronizing device 6 is installed.

[0096] More specifically, at a certain synchronizing device 6, the content maintained at the RFID tag 3 is used as being correct, and the content is copied directly to the wireless communication terminal 4. Furthermore, at another synchronizing device 6, the content maintained at the wireless communication terminal 4 is used as being correct, and the content is copied directly to the RFID tag 3.

[0097] According to this method, for example, at a synchronizing device 6 installed at a place of the beginning of a segment where the wireless communication terminal 4 is used, the content maintained at the RFID tag 3 at that time is used as being correct and is copied to the wireless communication terminal 4. At a synchronizing device 6 installed at a place of the end of the segment where the wireless communication terminal 4 is used, the content maintained at the wireless communication terminal 4 at that time is used as being correct and is copied to the RFID tag 3. Accordingly, change made to the wireless communication terminal 4 in the segment where the wireless communication terminal 4 can be written back to the RFID tag 3.

[0098] Furthermore, if an extra amount of information can be saved, a conceivable method is to include a timestamp in information maintained at the RFID tag 3 and/or the wireless communication terminal 4.

[0099] In this case, each time information is updated, the time information is recorded as a timestamp. When the synchronizing process is performed, the stamp of information maintained at the RFID tag 3 and the stamp of information maintained at the wireless communication terminal 4 are compared, and the newer updating time is considered as being correct, and based on this time, older information is overwritten with newer information.

[0100] It is effective for product management to connect the synchronizing device 6 to a server apparatus and to save information possessed by the RFID tag 3 or

the wireless communication terminal 4 in the server apparatus (the LAN wireless communication base station 9 or the like) on a network each time the synchronizing process is performed.

[0101] In this case, preferably, it is allowed to arbitrarily select information that is to be synchronized and information that is to be transferred to and maintained in a database on the server apparatus (the LAN wireless communication base station 9 or the like) among information stored in the RFID tag 3 or the data storage device 5.

[0102] Furthermore, although the maximum amount of information that can be maintained on the RFID tag 3 is limited to about several hundred bytes, it is readily possible to configure the wireless communication terminal 4 so that information of approximately several hundred Mbytes can be stored, so that it is possible to maintain much more information.

[0103] Thus, in a conceivable method of use, in a segment where information is maintained at the wireless communication terminal 4, regardless of the information capacity of the RFID tag 3, related data of a large volume, such as image data and audio data, is maintained as needed, and when the synchronizing process is executed, such large-volume information is saved only in a database on a server such as the LAN wireless communication base station 9 connected to the synchronizing device 6 and only a portion of the information is maintained in synchronization on the RFID tag 3.

[0104] Accordingly, it is possible to search the server later for related information on the basis of information such as the unique ID number of the RFID tag 3. This is effective for product management.

[0105] Conversely, when the synchronizing process is performed from the RFID tag 3 to the wireless communication terminal 4, it is possible to search for related large-volume information saved in a database on a server on the basis of information such as the unique ID number of the RFID tag 3, write the information to the wireless communication terminal 4, and use the information for subsequent processing.

[0106] By causing the synchronizing device 6 to write information stored in a database on a server such as the LAN wireless communication base station 9, which is another information management apparatus, on the RFID tag 3 or the data storage device 5, it becomes possible for the RFID tag 3 to obtain arbitrary information. This improves the value of the system drastically.

[0107] An example of application of a system according to the present invention to a product carriage system, a process carriage system, or the like will be described below.

[0108] First, an overview of this system will be described with reference to Fig. 3.

[0109] This system is a system in which a plurality of carriers 1 are moved on a predetermined track R, products are received from the production line in a loading area A, and the products are passed to a shipping line

in a shipping area B.

[0110] On the movement path on the track, an inspecting area C and a processing area D exist. In the individual areas, a worker performs inspection of products and performs processing for shipping in accordance with inspection results.

[0111] The carrier 1 is configured as shown in Fig. 1, and includes the managed object 2 and the wireless communication terminal 4 conforming to, for example, the IEEE 802.11g standard. The wireless communication terminal 4 is configured to perform communication with the synchronization controlling device 10 in the synchronizing device 6 via the wireless communication base station 7. Furthermore, the wireless communication terminal 4 is configured to be capable of performing communication with the wireless-enabled PDA 8 owned by a worker, or with the LAN wireless communication base station 9.

[0112] In the "loading area A" and the "shipping area B", synchronizing devices 6-1 and 6-2 are installed, which perform synchronizing processes between wireless communication terminals on carriers 1 and RFID tags 3 attached to products. The synchronizing devices 6 are connected via a network cable or the like to a product management server 12 that manages product information. The basic configuration of the synchronizing device 6 is shown in Fig. 2, which will be described later in detail.

[0113] Furthermore, in the "inspecting area C" and the "processing area D", wireless communication base stations 7-1 and 7-2 are provided, which intermediate communication between wireless communication terminals 4 on carriers 1 and the wireless-enabled PDA 8.

[0114] Now, an overview of the operation of the system according to this embodiment will be described in order.

[0115] Upon a carrier 1 reaching the "loading area A", a product (managed object 2) with an RFID tag 3 attached thereto is mounted on the carrier 1 from the manufacturing line. In the "loading area A", the synchronizing device 6-1 is installed so that information on the RFID tag 3 and information on the wireless communication terminal 4 are synchronized.

[0116] At this time, since no information regarding the product is attached to the wireless communication terminal 4, basically, the information on the RFID tag 3 is transferred and written to the wireless communication terminal 4. As a method for this operation, synchronization may be achieved by mechanically using a synchronization method of "using the information on the RFID tag 3 as being correct and writing the information on the wireless communication terminal 4" in the "loading area A". Alternatively, synchronization may be achieved by providing information with a timestamp in the RFID tag 3, checking whether newer information corresponding to the information maintained on the RFID tag 3 exists on the wireless communication terminal 4, and "using the information on the RFID tag 3 as being correct and writing the information to the wireless communication terminal 4" since such information is absent on the wireless communication terminal 4 as a result.

[0117] At this time, since the synchronizing device 6-1 in the "loading area A" is connected to the product management server 12, using the unique ID number of the RFID tag 3 as a keyword, additional information relating to the product and not written on the RFID tag 3 may be downloaded from the product management server 12 and written to the wireless communication terminal 4.

[0118] When the product has been mounted and information regarding the product has been written to the data storage device 5 on the wireless communication terminal 4 through the synchronizing process, the carrier 1 moves along the track R and reaches the "inspecting area C".

[0119] In the "inspecting area C", a worker having a wireless-enabled PDA 8-1 accesses the wireless communication terminal 4 on the carrier 1 via the wireless communication base station 7-1, performs inspection on the basis of product information maintained on the wireless communication terminal 4, and writes the result of inspection to the wireless communication terminal 4 using the wireless-enabled PDA 8-1. At this time, since the communication range of the wireless communication terminal 4 is large, the worker can perform writing to the wireless communication terminal 4 even at a distance where reading from or writing to the RFID tag 3 is usually not possible. Furthermore, although it is usually necessary for reading from or writing to the RFID tag 3 that the speed of movement of the carrier 1 be as low as approximately 1 km/h, in the case of the wireless communication terminal 4, reading or writing is allowed even during movement at a faster speed.

[0120] After passing through the "inspecting area C", the carrier 1 then reaches the "processing area D". In the "processing area D", a worker having a wireless-enabled PDA 8-2 accesses the wireless communication terminal 4 on the carrier 1 via the wireless communication base station 7-2, performs processing on the product on the basis of product information maintained on the wireless communication terminal 4 or inspection information attached in the "inspecting area C", and writes the result of processing to the wireless communication terminal 4. Alternatively, instead of simply writing the result, a picture or movie of the product may be captured and the captured data may be written to the wireless communication terminal 4 via the wireless communication base station 7-1. Similarly to the "inspecting area", there exists some flexibility regarding the distance for writing to the carrier 1 or the communication rate for writing to the carrier 1.

[0121] Finally, the carrier 1 reaches the "shipping area B", and when the carrier 1 passes through the synchronizing device 6-2 installed therein, information attached to the wireless communication terminal 4 (the data storage device 5) or changed information is transferred and written to the RFID tag 3. Regarding this decision, synchronization may be achieved by mechanically "using the information on the wireless communication terminal 4 as being correct and writing the information to the RFID tag 3" as a method of synchronization in the "shipping area D", or synchronization may be achieved by providing

information with a timestamp in the RFID tag 3 and the wireless communication terminal 4, comparing timestamps of information maintained on these devices, and overwriting older information with newer information.

[0122] At this time, the synchronizing device 6-2 in the "shipping area" is connected to the product management server 12, and information possessed on the wireless communication terminal 4 is recorded in a product information database of the production management server 12.

[0123] If the wireless communication terminal 4 has information exceeding the storage capacity of the RFID tag 3, such as captured data of a picture or a movie, such information is not transferred to the RFID tag 3 and is only recorded in the product information database. This makes it possible to perform searching later on the basis of the unique ID number of the RFID tag 3.

[0124] Even in a case where the RFID tag 3 must be detached from the product in the course of the process, by detaching the RFID tag 3 after performing the synchronizing process in the "loading area A" and attaching a new RFID tag 3 before performing the synchronizing process in the "shipping area D", the RFID system functions continuously without any problem.

[0125] Next, of the two synchronizing devices 6-1 and 6-2 in Fig. 3, the operation of the synchronizing device 6-1 will be described in detail with reference to Fig. 4.

[0126] In the synchronizing device 6-1, an RFID antenna 11 is provided so as to form a loop shape surrounding a track, and a carrier 1 passes through the center point of the loop of the antenna 11. Furthermore, the wireless communication base station 7 is configured so that, with its directive antenna, communication is allowed only in the vicinity of the loop of the RFID antenna 11 and the signal intensity becomes most intense in the proximity of the loop.

[0127] In a case where the carrier 1 moves on the track R and a synchronizing process is performed in an area of the synchronizing device 6, the RFID tag 3, the synchronization controlling device 10, and the wireless communication terminal 4 executes the following procedure.

[0128] First, for the purpose of reading of the RFID tag 3 by the read/write device RW-1, the carrier 1 reduces the speed of movement to approximately 1 km/h and enters the area. Since the speed is restricted only in the proximity of the read/write device RW, this control can be readily achieved.

[0129] When the carrier 1 passes through the loop of the RFID antenna 11, information on the RFID tag 3 attached to the managed object 2 on the carrier 1 is read by the read/write device RW of the synchronizing device 6, and is read into the synchronization controlling device 10.

[0130] In response to the event as a trigger, information maintained in the data storage device 5 of the wireless communication terminal 4 is also read into the synchronization controlling device 10 via the wireless communication base station 7. In the case where a plurality

of wireless communication terminals 4 that can perform communication with the wireless communication base station 7 exists, information of a wireless communication terminal 4 selected according to a priority of a factor such as an electric wave intensity or the like described earlier is read.

[0131] In this way, information on the wireless communication terminal 4 included in the carrier 1 and information on the RFID tag 3 attached to the managed object 2 carried by the carrier 1 are read into the synchronization controlling device 10. Then, these items of information under go a synchronization process according to the predetermined procedure described above, and then written respectively to the RFID tag 3 and the data storage device 5 of the wireless communication terminal 4, whereby re-writing is achieved.

[0132] Furthermore, the operation of the synchronizing device 6-2 will be described in detail using a specific example shown in Fig. 5.

[0133] The synchronizing device 6-2 is connected to a movable read/write device RW-2, and a worker places the read/write device RW-2 against the RFID tag 3 attached to the managed object 2 carried by the carrier 1, whereby synchronization is achieved. Furthermore, since the wireless intensity of the wireless communication base station 7 of the synchronizing device 6-2 is strong, the wireless communication base station 7 can uniformly cover a predetermined area having a certain size, and can communication with an object moving a considerable speed, so that communication can be performed similarly with a plurality of wireless communication terminals 4 within this area. Furthermore, in this area, even when the carrier 1 enters the area at a speed substantially the same as a normal speed (e.g., 10 km/h), communication with the wireless communication terminal 4 is allowed.

[0134] Upon entry of the carrier 1 into the area, the synchronization controlling device 10 saves the identification number of the wireless communication terminal 4, such as an IP address, in a list in a memory in the order of entry.

[0135] Then, a worker places the movable the read/write device RW-1 against the RFID tag 3 to read information on the RFID tag 3, the synchronization controlling device 10 performs the synchronizing process with an oldest terminal in the list saved in the memory, and then deletes information of the wireless communication terminal 4 on the memory. That is, in the list of the synchronization controlling device 10, a wireless communication terminal whose entry time is next oldest becomes a next subject of synchronization.

[0136] Alternatively, the following method may be used.

[0137] In a case where the unique ID number of the RFID tag 3 is included in information to be synchronized maintained in the wireless communication terminal 4, upon reading of information of the RFID tag 3 by the worker, unique ID numbers are read from all the wireless com-

munication terminals in the area, a wireless communication terminal 4 having a unique ID number matching that on the RFID tag 3 is selected, and the synchronizing process is performed with the wireless communication terminal 4.

[0138] According to the system described above, it is possible to communicate even with a remote object, for which it is difficult to use the RFID tag 3, so that it is possible to implement a more convenient production management system using a combination with a wireless system such as a wireless LAN.

[0139] This application claims the benefit of Patent Application No. 2006-042629 filed February 20, 2006 in Japan, and the content of the application is incorporated by reference herein.

Industrial Applicability

[0140] The present invention can be used for product carriage systems or process carriage systems.

Claims

1. An information synchronizing system comprising:

a wireless communication terminal including a first information storage device having a first wireless communication range and a second information storage device having a second wireless communication range, the second wireless communication range being larger than the first wireless communication range;
a read/write device that reads information from and writes information to the first information storage device;
a wireless communication base station capable of performing wireless communication with the wireless communication terminal; and
a synchronization controlling device that writes information stored in the first information storage device, the information being read using the read/write device, to the second information storage device via the wireless communication base station and the wireless communication terminal.

2. The information synchronizing system according to Claim 1,
wherein the synchronization controlling device writes information stored in the second information storage device, the information being read via the wireless communication terminal and the wireless communication base station, to the first information storage device using the read/write device.

3. An information synchronizing system comprising:

- a wireless communication terminal including a first information storage device having a first wireless communication range and a second information storage device having a second wireless communication range, the second wireless communication range being larger than the first wireless communication range;
- a read/write device that reads information from and writes information to the first information storage device;
- a wireless communication base station capable of performing wireless communication with the wireless communication terminal; and
- a synchronization controlling device that writes information stored in the second information storage device, the information being read via the wireless communication terminal and the wireless communication base station, to the first information storage device using the read/write device.
4. The information synchronizing system according to Claim 3,
- wherein the synchronization controlling device writes information stored in the first information storage device, the information being read using the read/write device, to the second information storage device via the wireless communication base station and the wireless communication terminal.
5. An information synchronizing system comprising:
- a first wireless communication terminal including a first information storage device having a first wireless communication range and a second information storage device having a second wireless communication range, the second wireless communication range being larger than the first wireless communication range;
- a read/write device that reads information from and writes information to the first information storage device;
- a wireless communication base station capable of performing wireless communication with the wireless communication terminal; and
- a synchronization controlling device that synchronizes information stored in the first information storage device and information stored in the second information storage device,
- wherein the synchronization controlling device writes the information stored in the first information storage device, the information being read using the read/write device, to the second information storage device via the wireless communication base station and the first wireless communication terminal, and
- wherein the synchronization controlling device writes the information stored in the second informa-
- tion storage device, the information being read via the first wireless communication terminal and the wireless communication base station, to the first information storage device using the read/write device.
6. The information synchronizing system according to Claim 5,
- wherein, the synchronization controlling device reads the information stored in the first information storage device using the read/write device upon the read/write device entering the first wireless communication range.
7. The information synchronizing system according to Claim 6,
- wherein, after the synchronization controlling device reads the information stored in the first information storage device using the read/write device, the synchronization controlling device writes the information that has been read to the second information storage device via the wireless communication base station and the first wireless communication terminal.
8. The information synchronizing system according to Claim 5,
- wherein the synchronization controlling device reads in advance the information stored in the second information storage device via the wireless communication base station and the first wireless communication terminal, and
- wherein the synchronization controlling device writes the information that has been read to the first information storage device using the read/write device upon the read/write device entering the first wireless communication range.
9. The information synchronizing system according to Claims 5 to 8, further comprising:
- a second wireless communication terminal,
- wherein the first wireless communication terminal and the second wireless communication terminal exist in a communication range of the wireless base station, and
- wherein the wireless base station performs communication only with the first wireless communication terminal.
10. The information synchronizing system according to Claim 9,
- wherein the intensity of a wireless signal of the first wireless communication terminal is greater than a predetermined intensity or the intensity of a wireless signal of the second wireless communication terminal.

11. The information synchronizing system according to Claim 9,
wherein communication with the wireless communication base station becomes possible earlier for the first wireless communication terminal than for the second wireless communication terminal.
12. The information synchronizing system according to Claim 9,
wherein the first wireless communication terminal has first unique information matching unique information of the first information storage device,
wherein the second wireless communication terminal has second unique information different from the first unique information, and
wherein the wireless communication base station reads the first unique information of the first wireless communication terminal and the second unique information of the second wireless communication terminal.
13. The information synchronizing system according to Claims 5 to 8, further comprising:

a second wireless communication terminal,

wherein a communication range of the wireless communication base station is set to be a range where wireless communication is allowed only with the first wireless communication terminal.
14. The information synchronizing system according to Claim 5,
wherein the wireless communication base station performs communication with the first wireless communication terminal via a wireless antenna having such a communication distance that only one carrier is possible to enter within the communication distance.
15. The information synchronizing system according to Claims 5 to 14,
wherein the first wireless communication terminal is provided on a movable carrier.
16. The information synchronizing system according to Claim 15,
wherein the read/write device, the wireless communication base station, and the synchronization controlling device are provided in a synchronizing device that moves relative to the carrier.
17. The information synchronizing system according to Claim 15,
wherein the wireless communication base station and the synchronization controlling device are provided in a synchronizing device that moves relative to the carrier, and
wherein the read/write device is provided on a portable device that can be carried separately from the synchronizing device.
18. The information synchronizing system according to Claim 15, further comprising:

a read/write-device moving device that moves the read/write device with the synchronizing device for a predetermined distance together with the carrier.
19. The information synchronizing system according to Claim 15, further comprising:

a read/write-device moving device that moves the read/write device for a predetermined distance together with the carrier.
20. The information synchronizing device according to Claims 5 to 19, further comprising:

a device that determines, in a case where the information in the first information storage device and the information in the second information storage device are to be synchronized, whether synchronization is to be achieved by using the information in the first information storage device or by using the information in the second information storage device according to a position where the synchronizing device is provided.
21. The information synchronizing system according to Claims 5 to 19, further comprising:

a device that, on the basis of time of communication regarding information to be synchronized maintained in the first information storage device and the first wireless communication terminal, which information is to be used for synchronization.
22. The information synchronizing system according to Claim 20 or 21,
wherein the device causes synchronization to be performed on the basis of information with latest communication time.
23. The information synchronizing system according to Claims 5 to 22,
wherein the synchronizing device is connected to an information management device, and
wherein the synchronizing device transfers at least part of the information stored in the first information storage device to the information management device so that the transferred information is maintained therein.

24. The information synchronizing system according to Claims 5 to 22,
 wherein the synchronizing device is connected to an information management device, and
 wherein the synchronizing device transfers at least part of the information stored in the second information storage device to the information management device so that the transferred information is maintained therein. 5
 10
25. The information synchronizing system according to Claims 5 to 22,
 wherein the synchronizing device is connected to an information management device, and
 wherein the synchronizing device transfers at least part of the information stored in the first information storage device and at least part of the information stored in the second information storage device to the information management device so that the transferred information is maintained therein. 15
 20
26. The information synchronizing system according to Claims 5 to 22,
 wherein the synchronizing device is connected to an information management device, and it is possible to arbitrarily select information to be synchronized and information to be transferred to and maintained in a database of the information management device among the information stored in the first information storage device. 25
 30
27. The information synchronizing system according to Claims 5 to 22,
 wherein the synchronizing device is connected to an information management device, and it is possible to arbitrarily select information to be synchronized and information to be transferred to and maintained in a database of the information management device among the information stored in the second information storage device. 35
 40
28. The information synchronizing system according to Claims 5 to 22,
 wherein the synchronizing device is connected to an information management device, and it is possible to arbitrarily select information to be synchronized and information to be transferred to and maintained in a database of the information management device among the information stored in the first information storage device and the information stored in the second information storage device. 45
 50
29. The information synchronizing system according to Claims 5 to 28, further comprising:
 55
 a device that writes information stored in a database of a management device connected to the synchronizing device to at least one of the

first information storage device and the second information storage device.

FIG. 1

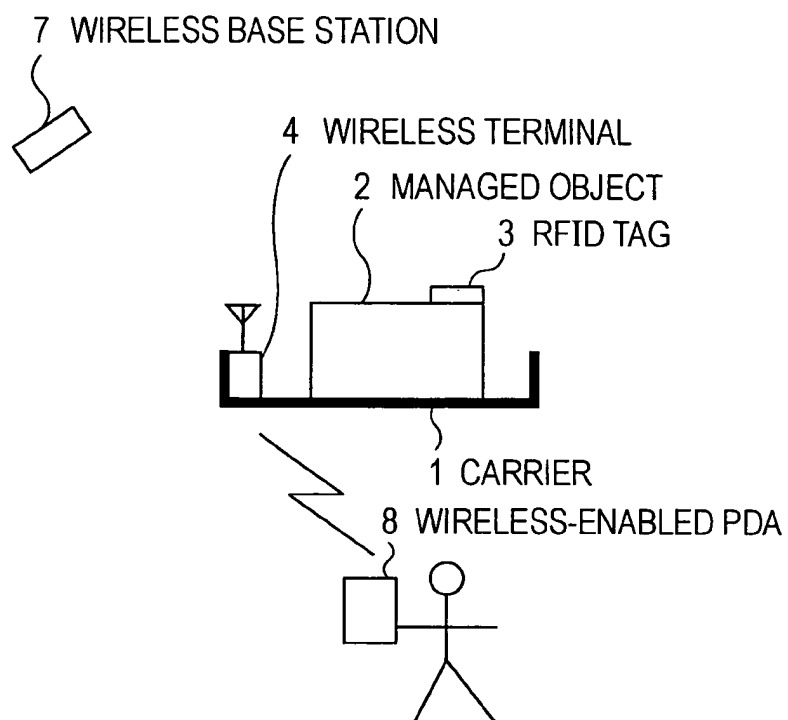


FIG. 2

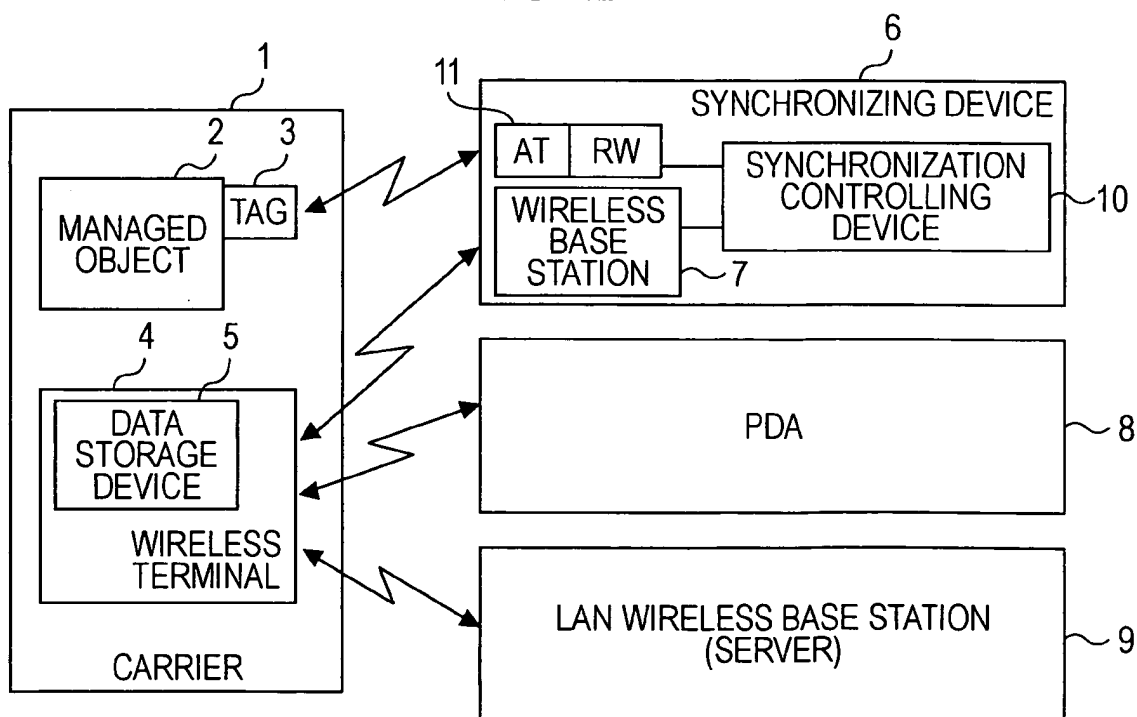


FIG. 3

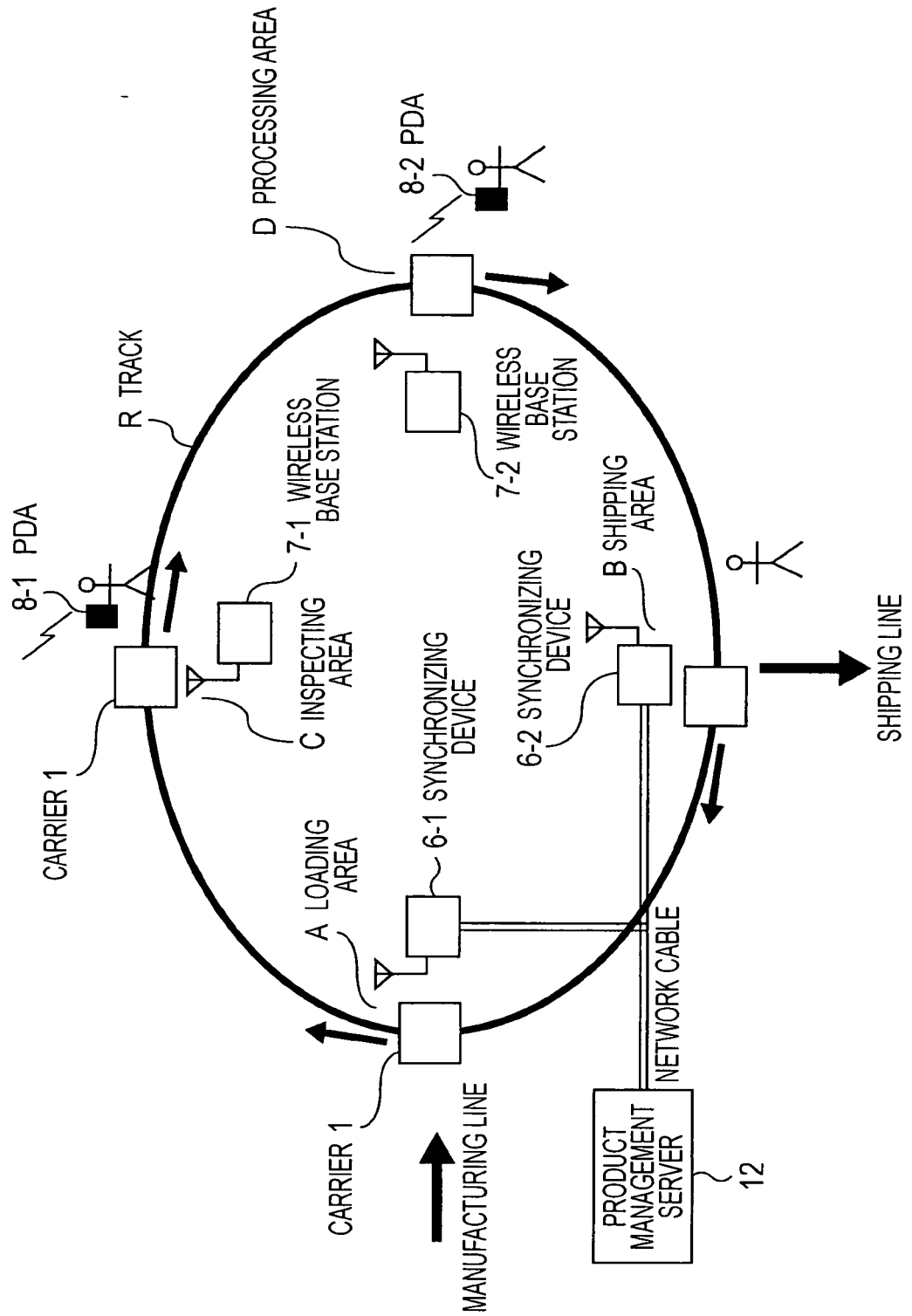


FIG. 4

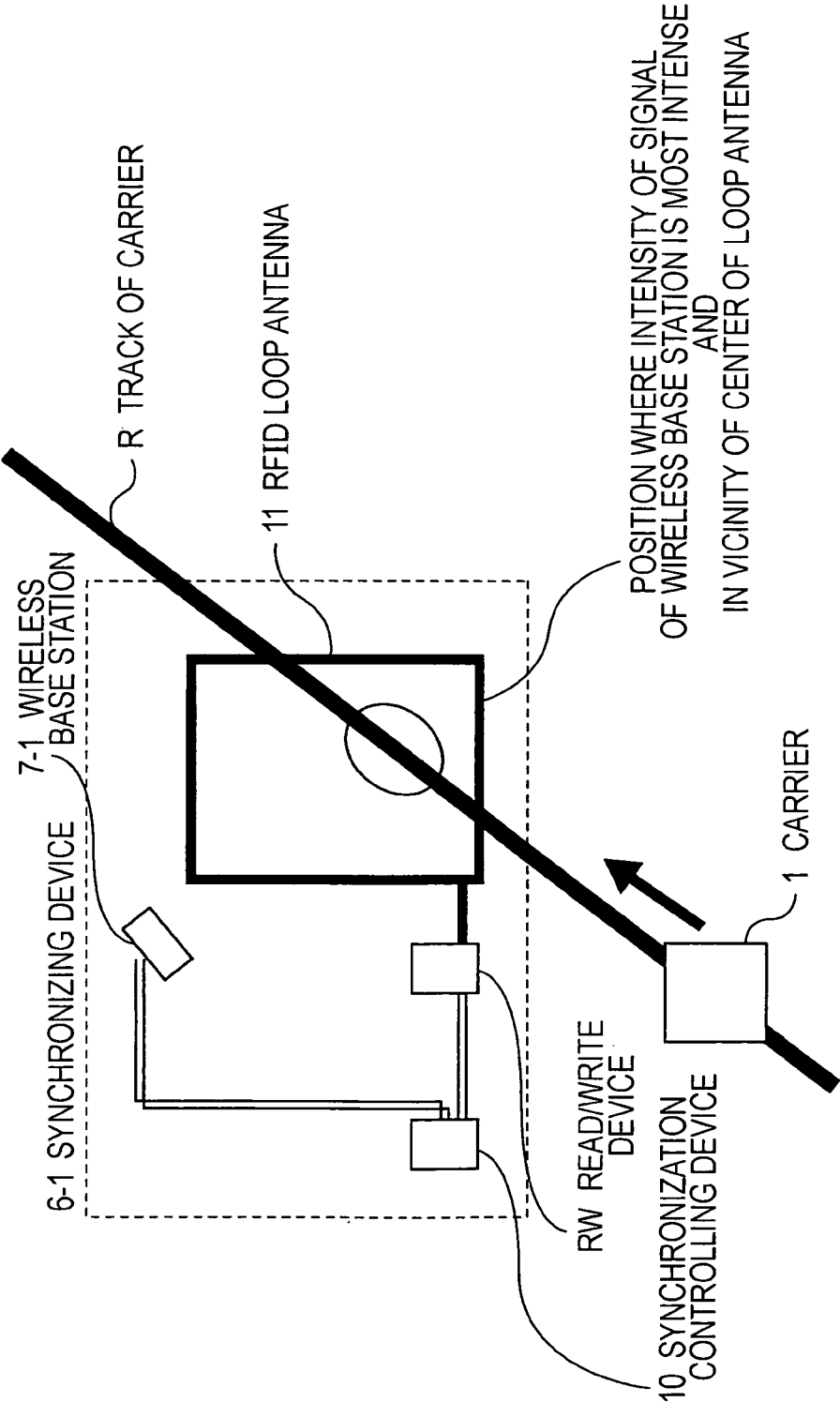
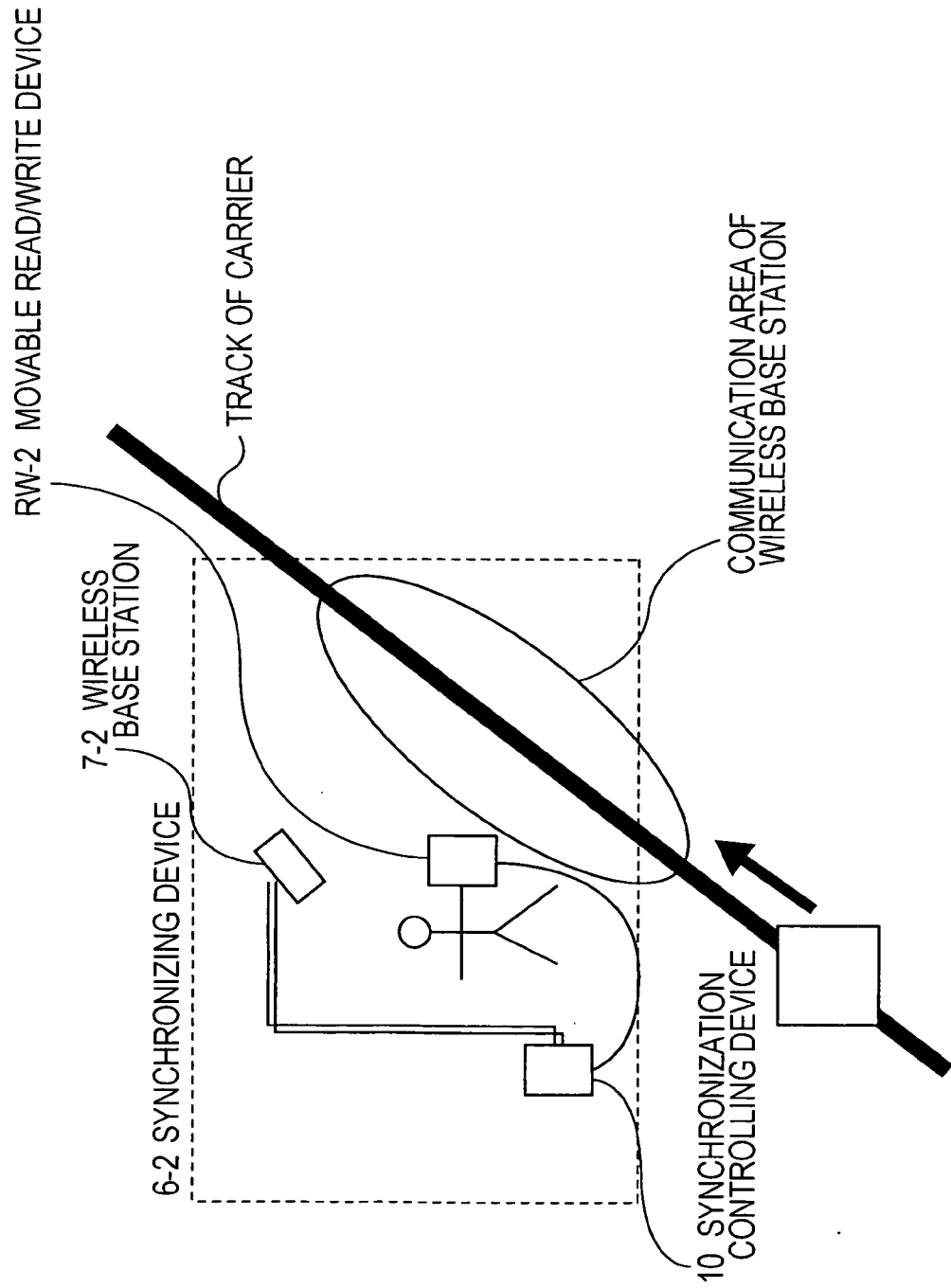


FIG. 5



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2007/053114

A. CLASSIFICATION OF SUBJECT MATTER <i>H04B7/26(2006.01) i, G06K17/00(2006.01) i</i>		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) <i>H04B7/24-H04B7/26, H04Q7/00-H04Q7/38, G06K17/00</i>		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched <i>Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2007</i> <i>Kokai Jitsuyo Shinan Koho 1971-2007 Toroku Jitsuyo Shinan Koho 1994-2007</i>		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2005-223822 A (Olympus Corp.), 18 August, 2005 (18.08.05), (Family: none)	1-29
A	JP 2003-212349 A (NTT Data Corp.), 30 July, 2003 (30.07.03), (Family: none)	1-29
☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.		
* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family		
Date of the actual completion of the international search 03 April, 2007 (03.04.07)		Date of mailing of the international search report 10 April, 2007 (10.04.07)
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Patent documents cited in the description

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